Semester | 5

V Semester

Technological Innovation Management & Entrepreneurship			Semester	V
Course and Course Code	HSMS	**BBM501**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:

After completion of the course, the students will be able to

- Understand basic skills of Management
- Understand the need for Entrepreneurs and their skills
- Identify the Management functions and Social responsibilities.
- Understand the identification of Business, drafting the Business plan and sources of funding.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE – 1

Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession (Selected topics of Chapter 1, Text 1).

Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making(Text 1).

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L2, L3

MODULE – 2

Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization-Process Departmentalization, Purpose Departmentalization ,Committees– Meaning, Types of Committees.

Staffing-Need and Importance, Recruitment and Selection Process.

Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication (Text 1).

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L2, L3

MODULE – 3

Leadership-Meaning, Characteristics, Behavioural Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process (Text 1).

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance (Text 1).

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 4

Entrepreneurship: Introduction, Evolution of the concept of Entrepreneurship, Entrepreneurship today, Types of Entrepreneurs, Entrepreneurship, Entrepreneurial competencies, Capacity Building for Entrepreneurs.

Identification of Business Opportunities: Introduction, Mobility of Entrepreneurs, Business opportunities in India, Models for opportunity Evaluation.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 5

Business plans: Introduction, purpose of a Business plan, contents of a Business plan, presenting a Business plan, why do some Business plan fail? Procedure for setting up an Enterprise.

Institutions supporting Business opportunities: Central level institutions- National Board for micro, small & medium Enterprises(NBMSME),MSME-DO, National Small Industries Corporation. State level institutions- state Directorate Industries and commerce, District Industries Centres, state financial Corporations, State Industrial Development Corporation(SIDC), State Industrial Area Development Board (SIADB). Other Institutions - NABARD, Technical consultancy organisation (TCO), Small Industries Development Bank of India(SIDBI), Export Promotion Councils, Non governmental Organisations.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Understand the fundamental concepts of Management and its functions.
2) Understand the different functions to be performed by managers/Entrepreneur.
3) Understand the social responsibilities of a Business.
4) Understand the Concepts of Entrepreneurship and to identify Business opportunities.
5) Understand the components in developing a business plan and awareness about various sources of funding and Institutions supporting Entrepreneur.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/

course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-4.
2) Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath,2nd Edition, Pearson Education 2018, ISBN 978-81-317-6226-4.

Reference Books

1) Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/110107094
- https://nptel.ac.in/courses/110106141
- https://nptel.ac.in/courses/122106031

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Digital Signal Processing			Semester	V
Course and Course Code	IPCC	**BBM502**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	4		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:

After completion of the course, the students will be able to

- To learn the basic concepts and properties of discrete-time signals and systems.
- To learn the frequency domain characteristics of discrete-time signals and systems.
- To design and implement digital filter design techniques
- It will provide knowledge of Digital filter.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
- Always start every class hour with preamble of what was covered in previous class and what would be discussed in the present class.
- Encourage group discussions and arrange debates on selected topics.
- Give exhaustive assignments on all topics so that students will be able to practice answering any questions in the University examinations that would come from nook and corner of the syllabus.
- Arrange seminars by the students on certain intriguing topics relevant to syllabus by the students.

MODULE – 1

Introduction: Signals and systems, Basic elements of Digital Signal Processing (DSP), analog to digital conversion (ADC), comparison between DSP and Analog Signal Processing (ASP) with applications of DSP. Discrete-time signals and systems: classification of signals, sampling process/theorem, aliasing effect and reconstruction, Classification of systems, input-output description of systems, Block-diagram representation of discrete-time systems.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Analysis of discrete-time systems: Linear convolution, causality and stability of discrete time systems, autocorrelation, cross correlation, z-transform and its properties, solving difference equations and analysis of discrete-time systems in z-domain, transfer function, pole-zero plot.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 3

Frequency analysis of discrete-time signals: Frequency response of LTI systems, ideal frequency selective filters, magnitude and phase response, Discrete-time Fourier Series, Properties of DFS, The Discrete Time Fourier Transform (DTFT), symmetry properties and theorems of DTFT. Energy density spectrum and power density spectrum.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 4

Discrete Fourier Transform (DFT): Introduction, Properties of DFT, symmetry properties, circular convolution, linear filtering methods based on DFT, Frequency analysis of signals using DFT, Efficient computation of DFT, Fast Fourier Transform (FFT) algorithms: radix-2 decimation-in-time (DIT) and decimation-infrequency (DIF)FFT algorithms.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3
MODULE – 5	
Design of digital IIR filters from analog filters: Implementation of discrete-time systems: and Infinite Impulse Response (IIR) structure Introduction to analog IIR filters, Butterworth approximation, Chebyshev approximation. Design of digital IIR filter: impulse invariance method, bilinear transformation, approximation derivative method. Frequency transformations in analog and digital domain. **Design of FIR filters**: Structures for the realization, Finite Impulse Response (FIR) Introduction to FIR filters, linear phase filters, symmetric and anti-symmetric filters, FIR design by Fourier approximation, window method, frequency sampling method, comparison between FIR and IIR filters	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

Sl. No	**Experiments using DSP kit**
1	Sampling of analog signals and study of aliasing.
2	Linear and circular convolution of two given sequences, Commutative, distributive and associative property of convolution.
3	Auto and cross correlation of two sequences and verification of their properties
4	Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum (using DFT equation and verify it by built-in routine).
5	Verification of DFT properties (like Linearity and Parseval 's theorem, etc.)
6	Design and implementation of Lowpass and High pass FIR filter to meet the desired specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal before and after filtering.
7	Obtain the Linear convolution of two sequences.
8	Compute Circular convolution of two sequences.
9	Audio applications such as to plot a time & frequency display of a microphone using DSP. Read a wav.file & match their respective specification
	Demonstration Experiments on DSP kit (For CIE)
10	Noise Removal: Removal of noise using Butterworth, Chebyshev I & II order Filters i. Add noise above 3khz & remove using adaptive filters ii. Interference suppressions using 400Hz tone.
11	Real time implementation of an audio signal to realize & Compute the response & Store using " FPGA based Software Defined Test & Measuring Instrument – Digital Filter Box, FIR Filter Builder

	& Data Logger"
12	Compute the correlation coefficient for the two given audio signals of the same length using " FPGA based Software Defined Test & Measuring Instrument – Digital Filter Box & FIR Filter Builder"

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Describe signals mathematically and understand how to perform mathematical operations on signals and to differentiate Sampling conditions
2) Compute the response of discrete-time systems to various input signals.
3) Evaluate and analyze the frequency domain characteristics of discrete-time systems
4) Design and implement different frequency selective FIR and IIR filters
5) Understand the significance of various filter structures and effects

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks - 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books

1) Oppenheim A V and Sehafer R W, "Discrete Time Signal Processing", Prentice Hall (1989).
2) Proakis J G and Manolakis D G, "Digital Signal Processing", Pearson Education India.
3) Udayashankara, "Real Time Digital Signal Processing", Publisher, Prentice- Hall of India Pvt Limited, 2010. ISBN, 8120340493, 9788120340497

Reference Books

1) D Ganesh Rao and Vineeth P Gejji, "Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231
2) Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition, McGraw Hill Education, 2013

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ee20/preview
- https://nptel.ac.in/courses/117102060
- https://nptel.ac.in/courses/108104100

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of Signals in Time domain and frequency domain
- Quizzes,
- Assignments,
- Seminars

Clinical Instrumentation			Semester	V
Course and Course Code	PCC	**BBM503**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	4:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours Theory		Total Marks	100
Credits	4		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:

After completion of the course, the students will be able to

- To understand various ICU equipment's
- To understand equipments and tests of Ophthalmology
- Analyze fundamental troubleshooting procedures for biomedical instruments

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.
- Always start every class hour with preamble of what was covered in previous class and what would be discussed in the present class.
- Encourage group discussions and arrange debates on selected topics.
- Try to arrange some industrial visits to understand various process automation techniques.
- Give exhaustive assignments on all topics so that students will be able to practice answering any questions in the University examinations that would come from nook and corner of the syllabus.
- Arrange seminars by the students on certain intriguing topics relevant to syllabus by the students.

MODULE – 1

Electrocardiogram: Action potentials in cardiac muscle, Characteristics of the normal ECG, Cardiac arrhythmias and their electrocardiographic interpretation- Abnormal sinus rhythms, Abnormal Rhythms by impulse conduction blocks, Premature contractions, Paroxysmal Tachycardia, Ventricular & Atrial Fibrillation, Atrial Flutter, Cardiac arrest. Heart sounds, Phonocardiogram, Valvular lesions (Abnormal heart sounds) (Text1: Chapter 9, Chapter 11, Chapter 13, Chapter 23)

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Catheterization Laboratory Instrumentation, Arrhythmia monitor, Exercise stress testing, Ambulatory monitoring instruments (Text2: 6.10, 7.2, 7.4, 7.5)

Fetal Monitoring Instruments: Cardiotocograph, Abdominal Fetal Electrocardiogram, Fetal Phonocardiogram (Text2: 8.1, 8.2.1, 8.2.2)

Oximeters: Oximetry, Ear Oximeter, Pulse Oximeter, Skin reflectance Oximeters, Intravascular Oximeter (Text2: 10.1, 10.2, 10.3, 10.4, 10.5)

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 3

Anatomy of human eye, Physiology of vision, Errors of refraction and their optical correction, Aqueous humor production and drainage, Strabismus.

Clinical methods: Spectacles and contact lenses, Refractive surgery, Snellen's Chart, Cover – uncover test, Maddox rod test, Maddox wing test.

(Text 3: Chapter 1, Chapter 2, Chapter 3, Chapter 9, Chapter 13, Chapter 21, Chapter 23)	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3
MODULE – 4	
Tonometry and its types, Perimetry – Peripheral Field Charting, Central Field Charting, Fundus Fluorescein Angiography, Electroretinography, Electro-oculography, Loupe & Lens Examination, Slit-Lamp Examination, Gonioscopy, Retinoscope- Principle, Procedure & Types, Refractometry, Keratometry-principle and types, subjective refraction, Ophthalmoscopy-Direct & Indirect (Text 3: Chapter 21, Chapter 23)	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3
MODULE – 5	
Cataract – list of classification only, Surgical techniques for cataract extraction – Intracapsular cataract extraction & Extracapsular cataract extraction for adulthood cataract, Phacoemulsification, Intraocular lens implantation. General considerations of Glaucoma, surgical procedures for Glaucoma, Vitreous Liquefaction, Vitreous Opacities, Vitreous Haemorrhage, Vitrectomy-types and techniques, Lasers in Ophthalmology, Cryotherapy in Ophthalmology, (Text 3: Chapter 8, Chapter 9, Chapter 10, Chapter 18)	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Analyze and interpret the types of heart abnormalities.
- Describe the constructional details of equipment's used in cardiology.
- Explain the basic principles of ophthalmology instruments.
- Discuss the clinical methods and surgical procedures in ophthalmology.
- Use few of the ophthalmological instruments for diagnostic purpose.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) "Textbook of Medical Physiology", Guyton & Hall, 11th Edition, Reed Elsevier Pvt. Ltd., 2007.
2) "Handbook of Biomedical Instrumentation", R S Khandpur, 2nd edition, McGrawHill E ducation, 2013.
3) "Comprehensive Ophthalmology", A. K. Khurana, 4th Edition, New Age International Ltd., 201

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Clinical Instrumentation Lab			Semester	V
Course Code	PCCL	**BBM504**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0		SEE Marks	50
Credits	1		Exam Hours	3
Examination type (SEE)	Practical			

Course objectives:

- Differentiate and analyse the biomedical signal sources.
- Elucidate cardiovascular system and related measurements.
- Explain the respiratory and nervous systems and related measurements
- Measure non-invasive diagnostic parameters.

Teaching-Learning Process (General Instructions)

- These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
- Always start every class hour with preamble of what was covered in previous class and what would be discussed in the present class.
- Encourage group discussions and arrange debates on selected topics.
- Give exhaustive assignments on all topics so that students will be able to practice answering any questions in the University examinations that would come from nook and corner of the syllabus.
- Arrange seminars by the students on certain intriguing topics relevant to syllabus by the students.
- Try to arrange some industrial visit to understand various process automation techniques.

Sl.NO	List of Experiments
1	Design and Test the bio-potential amplifiers for ECG/ or EEG/ or EMG
2	Design and Test the Notch Filter for 50 Hz and 60 Hz.
3	Testing and analysis of the following by hardware circuit/simulation (i) DC Defibrillator (ii) Pacemaker
4	Acquisition of ECG: (i) Single lead (iii) Three lead, and (iii) 12-Leads. Analysis of the acquired ECG in amplitude, time and frequency domain.
5	Acquisition and analysis (time & frequency) of EEG.
6	Acquisition and analysis of Lung Volumes and Lung Capacities using Spirometer.
7	Quantification and assessment of hearing ability using audiometer
8	Measurement of (i)corneal curvature using keratometer, (ii) Measurement of Visual Acuity using Snell's Chart, and (iii) Measurement of refractive errors.
9	Study Experiments: Baby incubator, Ventilator, Heart-lung machine, Dialysis machine, Pacemaker
	Demonstration Experiments on DSP kit (For CIE)
10	Determine the linear convolution of two given point sequences using FFT algorithm.
11	Design and test FIR filter using Windowing method (Hamming Hanning and Rectangular window) for the given order and cut-off frequency.
12	Design and test Butterworth 1st and 2nd order low & high pass filter.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Design and verify the different bio amplifiers & filters.
2) Acquire and analyze the ECG, EEG and respiratory signals
3) Analyze the visual ability and audibility using appropriate instruments.
4) Demonstrate the working of different diagnostic and therapeutic hospital equipment's.
5) Install and operate different types of hospital instruments.
6) Apply and analyze the signal processing algorithms on standard signals.

Conduct of Practical Examination:

1) All laboratory experiments are to be included for practical examination.
2) Students are allowed to pick one experiment from the lot.
3) Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4) Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE)

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE)

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the

conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

Suggested Learning Resources:

1) "Textbook of Medical Physiology", Guyton & Hall, 11th Edition, Reed Elsevier Pvt. Ltd., 2007.
2) "Handbook of Biomedical Instrumentation", R S Khandpur, 2nd edition, McGrawHill Education, 2013.
3) John Proakis, Dimitris G Manolakis, "Digital Signal Processing Principles", Algorithms and Application", PHI, 3rd Edition (2000).
4) S K MITRA, "Digital Signal Processing", 4th Edition, McGraw-Hill.
5) Avtar Singh, S. Srinivasan, "Digital Signal Processing Implementation", Brooks Cole.

Professional Elective Subjects

Biomedical Signal Processing			Semester	V
Course and Course Code	PEC	**BBM515A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Understand and Apply Various Methods for Analyzing Biomedical Signal Characteristics
- Acquiring and preprocessing of physiological signals to extract meaningful information
- Explore Alternative Techniques of Analyzing Biomedical Signals in Time and Frequency Domain
- To Understand the Functional Elements of Biomedical Instrumentation

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.
- Always start every class hour with preamble of what was covered in previous class and what would be discussed in the present class.
- Encourage group discussions and arrange debates on selected topics.
- Try to arrange some industrial visits to understand various process automation techniques.
- Give exhaustive assignments on all topics so that students will be able to practice answering any questions in the University examinations that would come from nook and corner of the syllabus.
- Arrange seminars by the students on certain intriguing topics relevant to syllabus by the students.

MODULE – 1

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. Action Potential and Its Generation, Origin and Waveform Characteristics of Basic Biomedical Signals ECG, EEG, EMG, PCG, ENG, ERPS, EGG, Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, Computer-Aided Diagnosis.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits, Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. Adaptive Noise Cancelling: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 3

Wavelet and Speech Processing: Introduction to wavelets, Time frequency representation, Discrete wavelet transform, pyramid algorithm, Comparison of Fourier transform and wavelet transform, Speech analysis – Cepstrum – Homomorphic filtering of speech signals, ECG signal characteristics – EEG analysis	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3
MODULE – 4	
Analysis of Bio-signals: Automatic analysis and classification of ECG, P-wave detection, QRS complex detection, Correlation analysis of ECG signals, Signal averaged ECG, Analysis of Heart Rate variability, Synchronized averaging of PCG envelopes, Analysis of PCG signal, Analysis of EMG signal	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3
MODULE – 5	
Medical Imaging Techniques: CT scan, ultrasound, NMR,PET, SPECT and X-Ray, Medical imaging modalities: X-Ray, computed tomography, Positron emission tomography, ultrasound, MRI	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Discuss the origin, nature and characteristics of biomedical signals.
2) Identify the noise and artifacts in biomedical signals and apply suitable filters remove.
3) Apply the signal averaging technique.
4) Evaluate various event detection techniques for the analysis of the EEG and ECG.
5) Apply different data compression techniques on biomedical Signals.
6) Develop algorithms to process and analyze biomedical signals for better diagnosis.
7) Understand the application of engineering methods for the improvement of human health

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Handbook of Biomedical Instrumentation-R. S. Khandpur, 2nd Edition, 2003, Tata McGraw-Hill
2) Rangayyan, R.M., 2015. Biomedical signal analysis (Vol. 33). John Wiley & Sons
3) Nishimura D, Principles of Magnetic Resonance Imaging, Stanford University Press
4) Introduction to Wavelets and Wavelet Transforms- A Primer, C. Sidney Burrus, Ramesh A. Gopinath and Haitao Guo (Prentice Hall)

Reference Books

1) Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill, D.C.Reddy, 2005
2) Biomedical Digital Signal Processing-Willis J.Tompkins, PHI,
3) Biomedical Signal Processing -Cohen. A, -Vol. I Time & Frequency Analysis, CRC Press, 1986.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Raspberry Pi			Semester	V
Course and Course Code	PEC	**BBM515B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Learn about the essentials of Raspberry Pi required for IoT
- Develop programming skills to make Raspberry Pi projects
- Use sensors and interface devices with Raspberry Pi
- Communicate wirelessly with other devices from distant locations

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.
- Always start every class hour with preamble of what was covered in previous class and what would be discussed in the present class.
- Encourage group discussions and arrange debates on selected topics.
- Try to arrange some industrial visits to understand various process automation techniques.
- Give exhaustive assignments on all topics so that students will be able to practice answering any questions in the University examinations that would come from nook and corner of the syllabus.
- Arrange seminars by the students on certain intriguing topics relevant to syllabus by the students.

MODULE – 1

Introduction to Raspberry Pi: Different Models of Raspberry Pi and its importance, Peripherals of Raspberry Pi, Applications of Raspberry Pi, Future of Micro Computing, Basic functionality of Raspberry Pi board and its Processor, Setting and configuring the board, differentiating Raspberry Pi from other platforms Text Book:1

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Introduction to Linux OS: Implications of Operating System on the behaviour of Raspberry Pi ,Overview of Linux and its terminal command, aptget update, aptget upgrade, Navigating the file system and managing the process, Text based user interface through the shell, Overview of graphic user interface. Text Book:1

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 3

Introduction to Python Programming Language : Python Programming Environment, Python Expressions, Strings, Functions, Function Arguments, Lists, List Methods, Control Flow, PIP, Numpy and customized libraries. Text Book:1 & 2

Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

MODULE – 4

Exploring Electronics with Raspberry Pi: I2C,SPi, UART, Working with RPiL, GPIO Library, Interfacing of Sensors and Actuators. Text Book:3

Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

MODULE – 5

Communication: Wired and Wireless Communication, TCP IP Configurations, SSH, Putty terminal Usage Text Books:3

Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Create functionality of Computer by wiring Raspberry Pi
2) Use Python based IDE and debug python code
3) Implement various communication protocols for wired and wireless communication
4) Students will be introduced to understand the various concepts of Cloud & Sensor Networks

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

1) Raspberry Pi 3 #: An Introduction to Python Scratch, Java Script and more, Gary Mitnick, Create Space Independent Publishing platform
2) Raspberry Pi for Python Programmers Cookbook, Tim Cox, Packt Publishing Limited,2nd Revised Edition,2016
3) Raspberry Pi User Guide, Eben Upton and Gareth Halfacreee, John Wilsey & Sons, 2016

Web links and Video Lectures (e-Resources):

- https://opensource.com/article/19/3/resources-raspberry-pi

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars
- Micro/Mini Projects

Biomedical Equipments			Semester	V
Course and Course Code	PEC	**BBM515C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives

After completion of the course, the students will be able to

- To understand the fundamental knowledge of Bio-medical Instrumentation,
- To understand the science associated with the measurement of biological variables such as pressure, temperature etc related to the human body,
- To understand the complexities associated with the measurement of the biological parameters and the care that is to be taken for the measurement since it is concerned with human life.
- Able to troubleshoot different Bio Medical machines / Instruments and repair them.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Arrange visits to nearby PSUs such as BHEL, BEL, ISRO, etc., and small-scale communication industries.
- Show Video/animation films to explain the functioning of various modulation techniques, Channel, and source coding.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, and develops thinking skills such as the ability to evaluate, generalize & analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the students' understanding.

MODULE – 1

Electrocardiograph, Block Diagram Description of an Electrocardiograph, The ECG leads, Effects of Artefacts on ECG Recordings.(Text 1: 5.1, 5.1.1, 5.1.2, 5.1.3) Electroencephalograph, Block Diagram Description of an Electroencephalograph. Other Biomedical recorders. (Text 1: 5.4, 5.4.1, 5.6) Bedside patient monitoring Systems, Measurement of Heart rate (Instantaneous heart rate meters). Measurement of Pulse rate. Blood Pressure measurement(Direct and Indirect-Korotkoff"s method,Rheographic method and Oscillometric Measurement method) Text 1: (6.3, 6.5, 6.5.2, 6.6, 6.7, 6.7.1, 6.7.2.1, 6.7.2.2, 6.7.2.4)

Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

MODULE – 2

Pulmonary Function Measurements:-Respiratory Volumes, Respiratory Capacities, Compliance and Related pressures, Dynamic Respiratory Parameters. Spirometry: - Basic Spirometer, Wedge Spirometer, Ultra Sonic Spirometer. Text 1: (13.1, 13.1.1, 13.1.2, 13.1.3, 13.1.4, ,13.2, 13.2.1,13.2.2, 13.2.3) Basic Audiometer: - General requirements of Audiometers. Masking in audiometer, Pure Tone and Speech Audiometer. Audiometer System (Bekesy). Evoked response Audiometry System. Calibration of audiometers. Hearing aids-Conventional and Digital hearing aid, Cochlear Implants Text 1: (17.3, 17.3.1, 17.3.2, 17.4, 17.5, 17.6,17.6.1, 17.6.2, 17.7, 17.8, 17.9, 17.9.1, 17.9.2, 17.9.3)

Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

MODULE – 3

Cardiac pace makers: Need for Cardiac pace maker. Types of pace makers:-external and Implantable pacemakers. Classification codes for Pacemakers. Ventricular synchronous demand pacemaker, Programmable pacemaker. Power sources for Implantable pacemakers. Text 1: (25.1, 25.1.1, 25.2, 25.3, 25.3.2, 25.3.3, 25.3.4, 25.3.7) Cardiac defibrillators: Need for defibrillator. DC defibrillator. Pacer-Cardioverter-defibrillator. Text 1: 26.1, 26.2, 26.4) Principle of surgical diathermy. Solid state electrosurgical machine. Safety aspects in electrosurgical units. Text 1: 27.1, 27.2, 27.3)

Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

MODULE – 4

Hemodialysis Machine: Function of the Kidneys. Changes in body fluids in renal disease. Artificial Kidney. Dialyzers: Parallel flow, coil, Hallow fibre type dialyzers. Performance analysis of dialyzers. Hemodialysis machine. (Text 1:30.1, 30.1.1, 30.2, 30.3.1, 30.3.2, 30.3.3, 30.3.4, 30.5) Heart lung machine (Cardiac assist device), Lithotripsy, Ventilator, Infant incubator. (Text 2: 13.3, 13.5, 13.6, 13.7)

Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

MODULE – 5

Introduction to man-Instrument system. Components of Man-Instrument system. Problems encountered in measuring a living system. Physiological effects of Electrical current. Shock Hazards from Electrical equipment's. Methods of accident prevention. (Text 3: 1.4, 1.5, 1.7, 16.1, 16.2, 16.3) Precautions to minimize Electric shock hazards. Safety codes for Electromedical equipment. (Text 1: 18.2.2, 18.3) Medical equipment maintenance: Types of maintenance repair organization, Levels of capability, types of organization. (Text 4: 26.4, 26.5, 26.6)

Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Define and analyze the ECG, EEG and BP signals.
2) Discuss the factors to be considered in the measurements ofrespiratory and audiometric signals.
3) Describe the principle and working of cardiac pacemakers, defibrillators and surgical devices.
4) Describe the principle and working of therapeutic instruments like Dialysis, heart-lung, ventilator, lithotripter and incubators.
5) Interpret the concepts involved with the measurement of man and instruments.
6) Discuss the physiological effects from electric shocksand maintenance of medical equipment's as per standards.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
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- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) "Handbook of Biomedical Instrumentation", R S Khandpur, 2nd edition, McGrawHill Education, 2013
2) "Medical Instrumentation, Application and Design", John G. Webster, 3rd Edition, John Wiley & Sons
3) "Biomedical Instrumentation and Measurements", Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd Edition, Prentice Hall of India Private Limited, 2001
4) "Introduction to Biomedical Equipment Technology", Joseph J Carr, John M. Brown, 4th Edition, Pearson Education, 2004.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108102096

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Computer Communication Networks			Semester	V
Course and Course Code	PEC	**BBM515D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Identify the different types of Network
- Explain the use of Computer Network
- Learn the basics elements of data communication system
- Build an understanding of the fundamental concepts of computer networking

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Always start every class hour with preamble of what was covered in previous class and what would be discussed in the present class.
- Encourage group discussions and arrange debates on selected topics.
- Try to arrange some industrial visits to understand various process automation techniques.
- Give exhaustive assignments on all topics so that students will be able to practice answering any questions in the University examinations that would come from nook and corner of the syllabus.
- Arrange seminars by the students on certain intriguing topics relevant to syllabus by the students.

MODULE – 1

Introduction: Uses of Computer Networks, Network Hardware, Network Software, Reference Models, Example Networks, Network Standardization

The Physical Layer: The Theoretical Basis for Data Communication, Guided Transmission Media, Wireless Transmission, Communication Satellites, The Public Switched Telephone Network.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2

MODULE – 2

The Data Link Layer: Data Link Layer Design Issues, Framing, Flow and Error Control, Error Detection and Correction, Sliding Window Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking, Go back n and sliding window protocols, Protocol Verification.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2

MODULE – 3

The Medium Access Control Sub Layer: The Channel Allocation Problem, Multiple Access Protocols: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA., Ethernet, Wireless LANS Broadband Wireless, Bluetooth: Architecture, Layers.

Teaching-Learning Process	Chalk and talk method, YouTube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 4

The Network Layer: Network Layer Design Issues, Routing Algorithms: Shortest Path Routing, Distance Vector Routing, Link State Routing, Hierarchical routing Congestion Control Algorithms: and quality of service: The Leaky Bucket Algorithm and Token Bucket Algorithm	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3
MODULE – 5	
The Transport Layer: The Transport Service. A Simple Transport Protocol, The Internet Transport Protocols (TCP and UDP), Performance Issues. **The Application Layer:** Domain Name System (DNS), electronic mail, worldwide web**.**	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, YouTube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Describe the basic computer network technology.
2) Describe the layering architecture of computer networks and distinguish between the OSI reference model and TCP/IP protocol suite.
3) Identify and analyze the different network topologies and protocols. Analyze the different network devices and their functions within a network
4) Identify the protocols and services of Data link layer.
5) Construct a network model and determine the routing of packets using different routing algorithms.
6) Identify the protocols and functions associated with the transport layer services.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.

2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Computer Networks: Andrews S. Tanenbaum, 4th Edition, Pearson Education, 2010.

Reference Books

1) ATM Networks concepts and Protocols – SumitKasera, Tata McGraw Hill 2nd edition, 2008
2) Data and computer networks- W STALLINGS 5th Edition, Prentice Hall of India 1998.

Web links and Video Lectures (e-Resources):

- https://sites.ecse.rpi.edu/~koushik/shivkuma-teaching/video_index.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Semester | 6

VI Semester

Medical Image Processing			Semester	VI
Course and Course Code	IPCC	**BBM601**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	4		Exam Hours	3
Examination nature (SEE)	Theory with Practical			

Course objectives:
After completion of the course, the students will be able to

- To have a comprehensive knowledge of the basics of medical image processing.
- To demonstrate an understanding of the image quality, signal to noise ratio (SNR) and modeling image degradation
- To describe the role of basic image processing technique such as image registration and image segmentation in high level image analysis

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L)does not mean only traditional lecture method, but different type of teaching methods like PPT presentation through LCD maybe adopted to develop the outcomes.
- Show Video/animation films to explain evolution of arm processor development technologies.
- Encourage collaborative (Group)Learning in the class
- Ask atleast three HOTS(Higher order Thinking)questions in the class ,which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Showthedifferentwaystosolvethesameprogramtaskandencouragethestudentstocomeupwiththeirown creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students understanding.

MODULE – 1

Introduction: Background, Examples of fields that use DIP, Fundamental steps in Digital Image Processing (DIP), Components of DIP system, Image sensing and acquisition, A simple image formation model, Image sampling and quantization. Basic relationship between pixels, Colour image processing fundamentals and models.
Text: Chapter 1, 2.3, 2.4, .2.5, 6.1, 6.2

Teaching-Learning Process RBT Levels	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2

MODULE – 2

Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Intensity level slicing, Bit plane slicing,

Histogram processing – Histogram equalization, Histogram matching (specification), Arithmetic/Logic operations – Image subtraction, Image averaging. Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters **Text**: 3.1, 3.2, 3.3, 2.6.1, 2.6.2, 2.6.3, 2.6.4, 3.4, 3.5, 3.6	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2
MODULE – 3	
Image Enhancement In Frequency Domain: Background, 2D-Discrete Fourier Transform and its Inverse, Basic properties of the 2D-Discrete Fourier Transform, Basics of filtering in the frequency domain. Image smoothing using frequency domain filters **–** Ideal lowpass filters, Butterworth lowpass filters, Gaussian lowpass filters; Image sharpening using frequency domain filters **–** Ideal highpass filters, Butterworth highpass filters, Gaussian highpass filters, Homomorphic filtering. **Text:** 4.1, 4.2, 4.5.5, 4.6, 4.7,4.8, 4.9	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2
MODULE – 4	
Image Restoration: Model of the Image degradation/restoration process, Noise models, Restoration using spatial filtering: Mean filters, Order statistic filters - Median filter, Min and Max filters, Midpoint filter. **Image Compression:** Fundamentals, Image compression models, Basic compression methods – Huffman coding, Arithmetic coding, LZW coding, Run-length coding. **Text:** 5.1, 5.2, 5.3.1, 5.3.2, 8.1, 8.2.1, 8.2.3, 8.2.4, 8.2.5	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L2, L3
MODULE – 5	
Image Segmentation: Fundamentals, Point detection, Line detection, Edge models, Edge detection, Canny edge detector. Thresholding, Region based segmentation. **Text**: 10.1, 10.2.1 – 10.2.6, 10.3, 10.4	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

Practical Component of IPCC *(May cover all / major modules)*

Sl. No	List of experiments to be performed
1	Display of an image, negative of an image.
2	Contrast stretching of a low contrast image.
3	Display of a histogram, and histogram equalization.
4	Bit plane slicing of an image.
5	Image enhancement by Intensity/Gray level slicing.
6	Implementation of FT for an image.
7	Implementation of High pass, Low pass filtering.
8	Mean and Median filtering of an image.

9	Implementation of image sharpening filters and edge detection using gradient filters.
10	Image Rotation (Clockwise and anticlockwise) and Flipping (Horizontal and Vertical)
11	Canny edge detection.
12	Image compression by DCT.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Define the general terminology of digital image processing.
2) Identify the need for image transforms and their types both in spatial and frequency domain.
3) Identify different types of image degradation and apply restoration techniques.
4) Describe image compression models and learn image compression techniques.
5) Explain and apply various methodologies for image segmentation.
6) Implement image processing and analysis algorithms.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks - 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.

- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

Semester End Examination for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books

1) Digital Image Processing - Rafael. C. Gonzalez and Richard. E. Woods, Third Edition, Pearson Education, 2008.

Reference Books

1) Fundamentals of Digital Image Processing - Anil K. Jain, 5th Indian Print, PHI, 2002.
2) Digital Image Processing and Computer Vision - Milan Sonka, India Edition, Cengage Learning.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars
- Mini project

Biomedical Digital Signal Processing			Semester	VI
Course and Course Code	PCC	**BBM602**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	4:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	4		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:

After completion of the course, the students will be able to

- To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
- To understand Sources and characteristics of noise and artifacts in bio signals.
- To understand use of bio signals in diagnosis, patient monitoring and physiological investigation
- To explore application of established engineering methods to complex biomedical signals problems.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOT (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the students' understanding.
- Give real time Assignments.

MODULE – 1

The nature of biomedical signals, objectives of biomedical signal analysis, difficulties encountered in biomedical signal analysis, Computer aided diagnosis. Text-1: 1.1, 1.3, 1.4, 1.5

Neurological Signal processing: Brain and its potentials, Electrophysiological origin of Brain waves, EEG signal and its characteristics, EEG analysis, Linear prediction theory, Autoregressive (AR) method, Recursive Estimation of AR parameters, Spectral error measure, Adaptive segmentation.

Text-2: 4.1 to 4.9

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1 and L2

MODULE – 2

Filtering for Artifacts Removal : Random noise, structured noise and physiological interference, stationary versus non-stationary processes, typical case study, time domain filters with application: Synchronized averaging,

moving-average filters Frequency domain filters with examples, removal of high frequency noise by Butterworth low pass filters, removal of low frequency noise by Butterworth high pass filter, removal of periodic artifacts by notch and comb filters. Weiner filter.

Text-1: 3.1, 3.1.1, 3.1.2, 3.3, 3.3.1, 3.3.2, 3.3.3, 3.4, 3.4.1, 3.4.2, 3.4.3, 3.5.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1 and L2

MODULE – 3

Basics of signal averaging, Signal averaging as a digital filter, A typical average, Software for signal averaging, Limitations of signal averaging. **Text-**3: 9.1 to 9.5

Data Acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of Sleepwave Transitions, Hypnogram Model Parameters. **Text-2:** 5.1 to 5.4

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L3 and L4

MODULE – 4

ECG Parameters and their estimation, A review of wiener filtering problem, Principle of an adaptive filter, the steepest descent algorithm, Adoptive noise canceller, Cancellation 60Hz Interference in ECG, Cancelling Donor heart Interference in Heart-transplant ECG, Cancellation of Electrocardiographic signals from the electrical activity of chest muscles, Cancelling of maternal ECG in Fetal ECG, Cancellation of higher frequency noise in electro-surgery.

Text-2: 7.4, 6.1, 6.2, 6.3, 6.5, 6.6.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 5

Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Other data compression techniques, Data compression techniques comparison.

Text-2: 8.1 to 8.5

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L3, L4 and L5

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Analyze the nature of Biomedical signals and related concepts
2) Apply filters to remove noise from biomedical signals.
3) Apply averaging technique on biomedical signals and extract the features of EEG signals.
4) Analyze event detection techniques for EEG and ECG signals.
5) Apply signal compression techniques on biomedical signals.
6) Write simple algorithms for biomedical signal processing

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley (IEEE Press)-2005
2) Biomedical Signal Processing- Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2005.
3) Biomedical Digital Signal Processing-Willis J.Tompkins, PHI, 2000.

Reference Books

1) Biomedical Signal Processing -Akay M, , Academic: Press 1994
2) Biomedical Signal Processing (Vol. I Time & Frequency Analysis) - Cohen.A,, CRC Press, 1986.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Professional Elective Course

Hospital Design, Planning and Management			Semester	VI
Course and Course Code	PEC	**BBM613A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- To understand and analyze effective hospital administration and financial management.
- To understand hospital supportive system for all types of hospital services.
- Evaluate the proper functioning and services provided by the hospitals.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various learning algorithms.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE – 1

Planning & Building a New Hospital: Role of Hospital in Health Care, Hospital Planning & Design, Guiding principle in Hospital facilities & services, Functional Plans for Hospital construction, Design items, Functional program & design stage, Planning the Hospital building.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Effective Hospital Management: Planning, Organization, Directing & Leading, Controlling, Financial Management
Administrative Service: Medical Record, Hospital Infection, Hospital Utilization Statistics, Material Management, Evaluation of Hospital services.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 3

Planning & Designing Medical Services: Out Patient service, Emergency service, Clinical laboratories, Radiology services, Radiation Therapy Department, Surgical Department, Nursing Department, Operation Theater, CSSD Nursing services.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 4	
Planning & Designing Engineering Services: Engineering Department, Maintenance management, Clinical [Biomedical] Engineering, Electrical System, Air Condition System, Water supply & sanitary system, Centralized Medical Gas System, Telecommunication System, Environmental Control, Safety & Security System, Disposal of Hospital Wastes.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 5	
Planning & Design of Supportive Services: Admitting Department, Medical Record Department, Centralized Sterilization & Supply department, Pharmacy Material Management, Food service Department, Laundry & Linen Services, House Keeping & Val entry Department.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1. Design and construct the hospital with an effective administration and financial management.
2. Plan and develop an effective hospital supportive system for all types of hospital services.
3. Evaluate the proper functioning and services provided by the hospitals.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Principles of Hospital Administration & Planning - by B. M.Sakharkar, Jaypee Publications, 1998.
2) Hospital Facilities, Planning & Management - by G. D. Kunders, TataMcGraw Hill, 2004.

Reference Books

1) Hospital Administration & Management - by S. L. Goel& R. KumarDeep& Deep Publications
2) Applied Clinical Engineering - by Barry N. Feinberg, Prentice Hall,1984.
3) Clinical Engineering Principle & Practices - By John G. Webster &Albert M. Cook, Prentice Hall

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Scientific and Analytical Instrumentation			Semester	VI
Course and Course Code	PEC	**BBM613B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- To introduce the basic concept of qualitative and quantitative analysis of a given sample.
- To impart various spectroscopic techniques and its instrumentation.
- To impart the concept of separation science and its application.
- To impart methods of Industrial analyzers and its application.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the students' understanding.

MODULE – 1

An Introduction to Instrumental Methods: Terms associated with Chemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation, Fundamental Laws of photometry (Text book 1).
IR Spectroscopy: Basic Components of IR Spectrophotometers, monochromators- Littrow mounting, Fourier Transform IR Spectroscopy (Text book 2).

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2

MODULE – 2

UV and Visible Spectrometry –Instrumentation: Radiation Sources, Wavelength selection: absorption filters, interference filters, Detector, Readout modules, Instruments for absorption photometry: single beam and double beam spectrophotometer. (Text book 1)	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 3	
Flame Emission and Atomic Absorption Spectroscopy: Introduction, Instrumentation for flame spectrometric methods, Flame emission spectrometry, atomic absorption spectrometry, Atomic fluorescence spectrometry, Interferences associated with Flames & furnaces, applications, comparison of FES and AAS. (Text book 1).	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 4	
Gas Chromatography: Chromatograph, Basics parts of a chromatograph: carrier gas supply, sample injection system, chromatographic columns: packed column & capillary column, Detectors: katharometer cell, differential flame ionization detector, electron capture detector.(Text book 2). **HPLC Instrumentation**: Mobile **–**phase delivery system sample introduction, separation columns, Detectors–Ultraviolet-Visible Photometers & Spectrophotometers, electrochemical (amperometric) detector, Differential refractometer. (Text book 1).	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 5	
Blood gas analyzer: Introduction, Blood pH measurements: electrodes for blood pH measurement, measurement of blood pCO_2, pO_2 , A Complete blood gas analyzer. **Air pollution monitoring instruments:** Representation of concentration of gases, Carbon monoxide (CO) -Non-dispersive infrared analyzer, Sulphur dioxide (SO_2)-Conductivitimetry, Nitrogen oxides-Using CO laser, laser opto-acoustic spectroscopy, Hydrocarbons-Flame ionization detector, Ozone-Chemiluminescence, Automated wet chemical air analysis, **Water pollution monitoring instruments**. (Text book 2)	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
Course outcomes (Course Skill Set): At the end of the course, the student will be able to: • Understand the principle, construction and working of UV & IR spectroscopy. • Understand the principle, construction and working of Flame Emission and Atomic Absorption Spectroscopy • Understand the principle, construction and working of Gas & High-performance Liquid Chromatograph. • Understand the application of analytical techniques in medicine, Industry, etc.	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Instrumental Methods of Analysis, 7th edition. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS Publishing & Distribution.
2) Handbook of Instruments – R.S. Khandpur, Tata McGraw Hill

Reference Books

1) Braun R.D., Introduction to Instrumental Analysis, McGraw –Hill Singapore,2006.
2) Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and francis group, 2007.
3) Principles of Instrumental Analysis 5th Edition – Douglas A. Skoog, F. James Holler, Timothy A. Niemen, Thomason Brooks/ Cole

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/103108100
- https://onlinecourses.nptel.ac.in/noc20_cy18/preview
- https://freevideolectures.com/course/3029/modern-instrumental-methods-of-analysis

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of analytical instruments
- Visit to chemical and food processing industries to observe the use of analytical instruments.
- Quizzes,
- Assignments,
- Seminars

Medical Imaging Techniques			Semester	VI
Course and Course Code	PEC	**BBM613C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Understand the origin of Electromagnetic radiation.
- Identify the different modalities X-ray, Ultrasound, CT, MRI, Nuclear medicine and Thermal Imaging.
- Understand the basic principles for each imaging modality.
- Understand the concept of image Guided Intervention and image guided surgery.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various modalities.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Topics will be introduced in multiple representations.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE – 1

X-Ray Imaging: Definition of x-ray, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors.
X-Ray Diagnostic Methods: Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography.
Computed Tomography: Conventional tomography, Computed tomography – Projection function, CT number. Recent developments – Digital radiography, Digital subtraction angiography (DSA). Biological effects of ionizing radiation. **.(Text book 1)**

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Ultrasound Imaging: Definition of ultrasound**,** Fundamentals of acoustic propagation (only theoretical concepts, no derivations) - Reflection and refraction, Attenuation, absorption & scattering, Doppler effect, Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution.
Ultrasonic Diagnostic Methods: Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-

mode), Motion mode (M-mode). Doppler methods, Duplex imaging, Color Doppler flow imaging, Biological effects of ultrasound. **.(Text book 1)**

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 3

Radionuclide Imaging: Introduction**,** Fundamentals of Radioactivity: Nuclear particles, Nuclear activity and half- life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radio nuclides, Generation & Detection of Nuclear Emission **–** Nuclear sources, Radionuclide generators, nuclear radiation detectors, Collimators**.**

Diagnostic Methods using Radiation Detector Probes: Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT: Principle and working. PET: Principle and working. (**Text book 1)**

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 4

Basics of Magnetic Resonance Imaging: Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Free induction decay (FID), Fourier spectrum of the NMR signal, Relaxation times, Pulse sequences.

Generation and Detection of NMR Signal: Introduction (block diagram and working), Magnet, Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging. Biological effects of magnetic fields-Brief summary of all types of effects**.(Text book 1)**

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 5

Thermal Imaging & Advances in Medical Imaging: Thermal Imaging: Medical Thermography, Physics of thermography, Infrared detectors, Thermographic equipment, Quantitative medical thermography, Pyroelctric vidicon camera . Applications of thermal imaging medicine **(Text book 2).**

Image Guided Intervention: Introduction, Stereotactic neurosurgery, Stereotactic neurosurgery based on digital image volumes- image acquisition, planning and transfer, Intraoperative Imaging- Intraoperative diagnostic imaging. **(Text book 3).**

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Describe the fundamentals of x-ray radiography and computed tomography, and analyze the system requirements.
2) Explain principles of ultrasound imaging and diagnostic methods and analyze the system requirements.
3) Discuss the fundamentals of radionuclide imaging, MRI, thermal imaging and analyze the system requirements.
4) Describe the concepts of image Guided Intervention and image guided surgery.
5) Design and develop prototype of simple medical imaging system.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Principles of Medical Imaging - by Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 1992.
2) Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
3) Fundamentals of Medical Imaging - by Paul Suetens, Cambridge University Press, 2002.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108105091
- https://onlinecourses.nptel.ac.in/noc21_bt50/preview
- https://nptel.ac.in/courses/102105090

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Biochemical Analysis and Techniques			Semester	VI
Course and Course Code	PEC	**BBM613D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:

After completion of the course, the students will be able to

- To describe the students with basic concepts of biomolecules, their structural classification and its metabolism.
- To define the biology of enzymes, hormones, its classification with properties, composition and functions of blood and urine.
- To investigate on clinical analytical methods used in biochemical techniques like hemocytometer, urine analysis and organ function tests – Liver, kidney, thyroid, pancreas and gastric system.
- To interpret on analytical techniques like microscopy, chromatography, electrophoresis, blood gas analyzers and analytical applications of spectrophotometry, fluorometry, atomic absorption and atomic emission spectroscopy.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- In addition to the traditional lecture method, innovative teaching methods may be adopted so that the delivered lesson shall enable the students to attain the outcomes.
- Show videos/animations to explain the fundamental concepts IIOT.
- Encourage collaborative (Group) learning in the class.
- Ask higher order thinking questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how concepts can be applied to the real world problem to enable the students to develop appropriate skills.
- Adopt flipped class technique by sharing the materials / sample videos prior to the class and have discussions on the that topic in the succeeding classes.

MODULE – 1

Biomolecules: Carbohydrates – General classification - Structure and functions - Lipids structure and function - storage lipids - Structure of proteins and amino acids – Conformation – Classification - Denaturation.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2

MODULE – 2

Metabolism: Carbohydrate - Blood glucose regulation - Hypo and hyperglycemia - Diabetus mellitus-types - Clinical features - Metabolic changes – Glycosuria – GTT – Aminoacids – Phenylketonuria - Lipids and Lipoproteins- Cholesterol- Factors affecting the level - Plasma lipoprotein **–** Types - Hyper and hypo-lipo proteinemias - Risk factor - Atheroscelorosis and fatty liver.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2
MODULE – 3	
Introduction to Enzymes and Hormones: Classification – chemistry - Nomenclature properties and mode of action of enzymes - Factor affecting enzyme activity - Concepts and types of hormones - Hormone actions **–** Pituitary **–** Thyroid **–**Parathyroid - Endocrine pancreas - Blood glucose regulation - Sex hormones and their functions - Immune system.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2
MODULE – 4	
Blood and Urine identification factors: Blood and urine - Composition and functions - Types and functions of RBC - WBC and platelet - Urine profile (creatinine – urea – albumin - sugar) - Color of urine - Specific gravity. **Clinical analytical methods:** Hemocytometer - Orine analysis - Organ function tests - Liver function tests - Kidney function tests - Thyroid function tests - Adrenal function tests - Pancreatic function tests - Gastric function tests.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2
MODULE – 5	
Analytical techniques: Microscopy - Principles of phase contrast - Interference and polarized light microscopy - Principle and applications of Chromatography – Electrophoresis - Flame photometry – Auto analyzers -Blood gas analyzers – Principle - Instrumentation and analytical applications for spectrophotometry – Fluorometry - Atomic absorption spectroscopy - Inductively coupled plasma - Atomic emission spectroscopy.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2
Course outcomes (Course Skill Set): At the end of the course, the student will be able to: 1) Comprehend the basic concepts of biomolecules and its functional classification 2) Ability to understand the metabolism of carbohydrates, proteins and fats with its factors affecting and deficiency disorders. 3) Comprehend the mechanism of enzymes and its classification with its modes of action. 4) Ability to understand the concepts and types of hormones, its physiological actions and immune system 5) Comprehend the knowledge on composition and functions of blood, formation of urine, composition of urine – creatinine, urea, albumin and sugar. 6) Ability to understand the instrumentation and principle concepts of Hemocytometer, organ function tests, microscopy and various analytical techniques. 7) Ability to understand the knowledge about analytical techniques and its significant usage in medicine.	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) David L. Nelson and Michael M. Cox (University of Wisconsin-Madison) "Lehninger Principles of Biochemical" 2017 7th edition, Wisconsin.

Reference Books

1) Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J Kennelly and P. Anthony Weil, "Herpars Illustrated Biochemistry " 2015 30th Edition, McGraw Hill Education, Columbus, USA.
2) Satyanarayana "Biochemistry" 2017 5th dition Elsevier, Amsterdam.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Open Elective Course

Biomedical Transducers and Medical Instrumentation			Semester	VI
Course and Course Code	OEC	**BBM654A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Gain the knowledge of working principle and construction details of Biomedical Transducers.
- Acquire the knowledge of transducer applications to access the biological signals.
- Access the performance of various Biomedical Transducers.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only the traditional lecturer method, but a different type of teaching method may be adopted to develop the outcomes.
- Show video/ animation films to explain the functioning of various techniques.
- Encourage group learning in the class.
- Try to arrange some industrial visit to understand various Lasers.
- Give assignments on all topics so that the students will be able to practice any question in the University examination.
- Arrange seminars by the students on certain topics relevant to syllabus.

MODULE – 1

Fundamental Concepts and Basic Transducers: Introduction, Classification of Transducers**,** Classification of transducers, Performance characteristics of Transducers, Displacement, Position and Motion Transducers, Pressure Transducers, Photoelectric Transducers, Optical fibre sensors and Smart sensors.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 2

Bioelectric Signals and Electrodes: Sources of Biomedical Signals, Origin of Bioelectric Signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes–Electrode-tissue interface, Electrolyte-Skin interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 3

Recording Systems: Basic recording system, General considerations for signal conditioners, Preamplifiers, Biomedical signal analysis techniques, Signal processing techniques, Writing systems, Direct writing recorders, Ink Jet recorders, Potentiometric Recorders, Tape Recorders and Digital Recorders.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 4	
Clinical Laboratory Instruments: Clinical thermometer probes, tympanic thermometers, telemetering capsules. Photoelectric Transducers: photovoltaic cells and photoemissive cells. Spectrophotometer, Colorimeter, Automated Biochemical Analysis Systems, Clinical Flame Photometers and Selective-ion Electrodes Based Electrode Analysers. Blood Cell Counters.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 5	
Flow Measurement: Requirements for measurement ranges – blood flow in a single vessel, tissue blood flow, and respiratory gas flow. Electromagnetic flowmeters – principle, methods of magnetic field excitation, perivascular probes, intravascular probes. Ultrasonic blood flowmeters– propagation of ultrasound in the tissue, ultrasonic Doppler flowmeters, blood flow measurement through Doppler imaging. Cardiac Output Measurement – Indicator dilution method, Dye Dilution method, Thermal Dilution Method, impedance cardiography.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Explain the working principle and construction details of Transducers.
2) Improve the measurement techniques through different approach.
3) Practically can implement the technology in measurement field.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Biomedical Transducers and Instruments – Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
2) Handbook of Biomedical Instrumentation- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003.

Reference Books

1) Biomedical Instrumentation and Measurement **–** Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, 2nd Edition, Prentice-Hall India Pvt. Ltd., 2004.
2) Transducers and Instrumentation -D. V. S. Murty Prentice Hall India Pvt ltd. 2nd Edition

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Fundamentals of Medical Imaging Techniques			Semester	VI
Course and Course Code	OEC	**BBM654B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Understand the origin of Electromagnetic radiation and its interaction with matter.
- Identify the different modalities X-ray, Ultrasound, CT, MRI, and Nuclear medicine.
- Understand the basic principles for each imaging modality.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only the traditional lecturer method, but a different type of teaching method may be adopted to develop the outcomes.
- Show video/ animation films to explain the functioning of various techniques.
- Encourage group learning in the class.
- Try to arrange some industrial visit to understand various Lasers.
- Give assignments on all topics so that the students will be able to practice any question in the University examination.
- Arrange seminars by the students on certain topics relevant to syllabus.

MODULE – 1

X-Ray Machines and Radiography: Fundamentals of X-ray – Electromagnetic radiation, Interactions between Xrays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, Xray detectors, Biological effects of ionizing radiation.
X-Ray Diagnostic Methods: Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Computed Tomography: Principle of CT, System components, Gantry geometry, Patient dose in CT scanners. Algorithms for image reconstruction, CT number, Spiral CT. Recent developments .Digital Radiography- Digital subtraction angiography (DSA), Dynamic spatial reconstructor (DSR), Image artifacts and Image characteristics.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 3

Ultrasound Imaging: Fundamentals of acoustic propagation - Characteristic impedance, Intensity, Reflection and refraction, Attenuation, Doppler effect. Generation and detection of Ultrasound-

Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution, Focusing, Arrays. Ultrasonic Diagnostic Methods: Pulse echo systems- Amplitude mode (A-mode), Brightness mode (Bmode), Motion mode (M-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 4

Radionuclide Imaging: Introduction, Fundamentals of Radioactivity **–** Nuclear particles, Nuclear activity and halflife, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission **–** Radionuclide generators, nuclear radiation detectors, Collimators, Diagnostic methods using radiation detector probes – Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT, PET.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 5

Basics of Magnetic Resonance Imaging: Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences.

MRI System & Imaging Methods: Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging, Characteristics of MRI images- Spatial resolution, image contrast. Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic fields.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Describe the fundamentals of x-ray radiography and analyze the system requirements.
2) Explain principles and applications of Computed Tomography system requirements.
3) Discuss the fundamentals of Ultrasonic imaging and analyze the system requirements.
4) Describe the fundamental concepts of Radionuclide Imaging and analysis of the system.
5) Discuss the physics and Instrumentation of MR imaging system.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Principles of Medical Imaging **–** by Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 1992.
2) Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
3) Fundamentals of Medical Imaging – by Paul Suetens, Cambridge University Press, 2002.

Reference Books

1) The Physics of Medical Imaging – by Steve Webb (Editor), Adam Hilger, Bristol and Philadelphia Publications, 1988.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108105091
- https://onlinecourses.nptel.ac.in/noc21_bt50/preview
- https://nptel.ac.in/courses/102105090

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars
- Visit to hospitals and diagnostic centres.
- Write programs to implement image reconstruction algorithms.

Rehabilitation Engineering and Assistive Technology			Semester	VI
Course and Course Code	PEC	**BBM654C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- To understand basic knowledge of rehabilitation
- To analyse Gait and locomotion
- To know and understand various rehabilitation assistive devices.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the students' understanding.

MODULE – 1

Introduction to Rehabilitation: Introduction Types of physical impairments, Principles of Rehabilitation, Motor, Sensor and Communication disorders. Intelligent prosthetic knee & arm. Advanced automatic prosthetics and orthotics. Prevention and cure of visual impairment, Electronics travel appliances, path sounder, laser cane, ultrasonic torch and guide, light probes, obstacle sensors, electro cortical prosthesis, classification.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2

MODULE – 2

Therapeutic Exercise Technique: Coordination Exercises, Balance Training, Gait, Pathological Gaits, Gait Training – Crutch Walking: Patterns of Gait, Relaxation exercises, Methods for training Relaxation, Strengthening exercises, Mobilization exercises.

Principles in Management of Communication: Communication, Speech, Language, Aphasia, Dysarthria, Speech therapy, Dysphagia, Communication for Visually impaired, Types of visual aids, Writing aids.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 3

Orthotic Devices in Rehabilitation Engineering: Definition, General Principles of Orthosis, Biomechanics of Orthosis, Classification, Material and fabrication for lower limb Orthosis, Calipers – Foot Orthoses, Ankle-Foot Orthosis, Knee-Ankle-Foot Orthosis, Hip-Knee-Ankle-Foot Orthoses, Functional Electrical Stimulation, Spinal Orthosis- Cervical, Head cervical Orthosis, Head cervical thoracic orthosis, Thoraco lumbar sacral orthosis, Lumbosacro-orthosis, Splints-its functions & types.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 4

Subjective and objective measurement methods. Characterizing human systems, and assertive devices. Biomaterials outlook for organ transplant, design considerations evaluation process. Engineering design of artificial heart and circulatory assist devices, Implementation and implantation aspects.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 5

Computer application in rehabilitation engineering; Interfaces in compensation for visual perception and improvement of orientation and mobility, rehabilitation aids for mentally impaired. Physical therapist, Occupational therapist, Prosthetist-Orthotist, Rehabilitation nurse, Speech pathologist, Psychologist and child development Specialist, Horticultural Therapist, Music therapist, Creative Movement. Therapist, Dance and play Therapist, Recreational therapist, Biomedical engineer.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Define rehabilitation and explain the composition of rehabilitation team.
- Discuss the engineering principles of rehabilitation engineering.
- Apply engineering skills in the development of prosthetic and orthotic devices.
- Evaluate the orthopedic design and applications.
- Apply the principles of engineering in the development of mobility aids for physically handicap.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered

- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Rehabilitation Medicine - By Dr. S. Sunder, 3rd Edition, Jaypee Medical Publications, Reprint 2004.
2) Biomedical Engg., Handbook, Bronzino J. D., CRC press (New York),1995

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Virtual Bio-Instrumentation			Semester	VI
Course and Course Code	OEC	**BBM654D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	3		Exam Hours	3
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- To understand basic concepts of LabVIEW and BioBench software
- To realize the applications of LabVIEW in ECG,EEC EMG.
- To understand Healthcare Information Management Systems using Information Science and Technology.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only the traditional lecturer method, but a different type of teaching method may be adopted to develop the outcomes.
- Show video/ animation films to explain the functioning of various techniques.
- Encourage group learning in the class.
- Try to arrange some industrial visit to understand various Lasers.
- Give assignments on all topics so that the students will be able to practice any question in the University examination.
- Arrange seminars by the students on certain topics relevant to syllabus.

MODULE – 1

Graphical System Design (GSD): Introduction, GSD model, Design flow with GSD, Virtual Instrumentation, Virtual Instrumentation and traditional instrumentation, Hardware and software in virtual instrumentation, Virtual Instrumentation for test, control and design, GSD using LabVIEW, Graphical programming and textural programming.

Introduction to LabVIEW: Introduction, Advantages of LabVIEW, Advantages of LabVIEW, Software environment, Creating and saving a VI, Front panel toolbar, Block diagram toolbar, Palettes, Shortcut menus, Property dialog boxes, Front panel controls and indicators, Block diagram, Data types, Data flow program, LabVIEW documentation resources, Keyword shortcuts.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Modular Programming: Introduction, Modular Programming in LabVIEW, Build a VI front panel and block diagram, ICON and connector pane, Creating an icon, Building a connector pane, Displaying subVIs and express VIs as icons or expandable nodes, Creating subVIs from sections of a VI, Opening and editing subVIs, Placing subVIs on block diagrams, Saving subVIs, Creating a stand-alone application.

Data Acquisition: DAQ software architecture, DAQ assistant, Channels and task configurations, Selecting and configuring a data acquisition device, Components of computer based measurement system.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 3

General Goals of Virtual Bio-Instrumentation (VBI): Definition of VBI and importance, General Goals of VBI applications. Basic Concepts: DAQ basics, Lab VIEW basics, BioBench basics.

Neuromuscular Electrophysiology (Electromyography): Physiological basis, Experiment set up, Experiment descriptions, Trouble shooting the nerve **–**Muscle Preparation.

Cardiac Electrophysiology (Electrocardiology): Physiological basis, Experiment descriptions.

Cardiopulmonary Applications: Cardiopulmonary measurement system, How the Cardiopulmonary measurement system works, Clinical Significance

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 4

Medical Device Development Applications: The Endotester – A Virtual Instrument –Based Quality control and Technology, Assessment System for surgical video Systems: Introduction, Materials and Methods, Endoscope Tests, Results, Discussion.

Fluid Sense Innovative IV Pump Testing: Introduction, The test System, Training Emulator

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 5

Healthcare Information management Systems:

Medical Informatics: Defining medical informatics, Computers in medicine, Electronic Medical record, Computerized physician order entry, Decision support. Information Retrieval, Medical Imaging, Patient Monitoring, Medical Education, Medical Simulation. Managing Disparate Information: ActiveX, ActiveX Data Objects(ADO), Dynamic Link Libraries, Database Connectivity, Integrated Dash boards.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Describe the Graphical System Design approach & basic features and techniques of LabVIEW.
2) Use the Modular Programming concepts for creation of VIs & employ DAQ assistant for configuration of hardware devices.
3) Discuss the basic concepts of DAQ Systems, LabVIEW , and BioBench software.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Virtual Instrumentation using LabVIEW by Jovitha Jerome, PHI Learning Private Limited, 2010. (Module 1 & 2)
2) "Virtual Bio-Instrumentation" Biomedical, Clinical, and Healthcare Applications in Lab VIEW.by Jon B. Olansen and Eric Rosow, Prentice Hall Publication, 2002.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes,
- Assignments,
- Seminars

Biomedical DSP Lab			Semester	VI
Course Code	PCCL	**BBML606**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0		SEE Marks	50
Credits	1		Exam Hours	3
Examination type (SEE)	Practical			

Course objectives:

- Understand the mathematical principles of continuous and digital signal processing.
- Apply knowledge of math, engineering and science to understand the principle of biomedical signal processing.
- Understand how to apply specific mathematical techniques to solve problems in the areas of biomedical signals

Teaching-Learning Process (General Instructions)

- These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
- Always start every class hour with preamble of what was covered in previous class and what would be discussed in the present class.
- Encourage group discussions and arrange debates on selected topics.
- Give exhaustive assignments on all topics so that students will be able to practice answering any questions in the University examinations that would come from nook and corner of the syllabus.
- Arrange seminars by the students on certain intriguing topics relevant to syllabus by the students.
- Try to arrange some industrial visit to understand various process automation techniques.

Sl.NO	Experiments
1	Write a program to Compute Linear & Circular convolution, Cross & Auto correlation using a biomedical signal
2	Write a program to Compute DFT, FFT, Power spectrum and power spectral density of a biomedical signal.
3	Write a program to Display Static and Moving ECG signal.
4	Write a program to Implement 50Hz notch filter for ECG signal and display PSD.
5	Write a program to Implement IIR filters for ECG (LPF,HPF,BPF)
6	Write a program to Implement Low-Pass FIR filter for ECG
7	Write a program to Implement FIR Filter using Kaiser Window.
8	Write a program to detect QRS complex and measure the heart rate of a given ECG signal
9	Write a program to improve the SNR using signal averaging technique
10	Write a program to obtain the DCT & IDCT of ECG signal
11	Write a program to down sample the given ECG signal
12	Write a program to obtain Adaptive noise cancelling

13	Write a program to compress the data using Turning point & FAN algorithm

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1) Apply the signal processing techniques on biomedical signals and evaluate their performance.
2) Develop/Write signal processing algorithms for the analysis of biomedical signals

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE)

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE)

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

Suggested Learning Resources:

1) Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley (IEEE Press)-2005
2) Biomedical Signal Processing- Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2005.
3) Biomedical Digital Signal Processing-Willis J.Tompkins, PHI, 2000.
4) Biomedical Signal Processing -Akay M, , Academic: Press 1994
5) Biomedical Signal Processing (Vol. I Time & Frequency Analysis) - Cohen.A,, CRC Press, 1986.

Ability Enhancement Course / Skill Development Course V

Medical Device Development			Semester	VI
Course and Course Code		**BBM657A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	01		Exam Hours	01
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Understand the basic concepts medical design innovations.
- Analyze the product requirements and classification.
- Analyze the design engineering concepts.
- Apply the project management and sustainability.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only the traditional lecturer method, but a different type of teaching method may be adopted to develop the outcomes.
- Show video/ animation films to explain the functioning of various techniques.
- Encourage group learning in the class.
- Try to arrange some industrial visit to understand various Lasers.
- Give assignments on all topics so that the students will be able to practice any question in the University examination.
- Arrange seminars by the students on certain topics relevant to syllabus.

MODULE – 1

MedTech Innovation: Introduction, the status of bio-innovation in India, DALY, MedTech Innovation, New medical device steps, Common Myths, Bio design process, clinical immersion, need filtration, Need Specification document, case studies, Market Segmentation, Concept Generation and Selection, Perfint Maximo Example.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 2

Product Requirement: Classification of Medical Device (FDA/CE/CDSCO), Requirement Analysis: Functional, Safety, Usability, User interface, Clinical Workflow, Internal Interface, Working environment, Infrastructure, Safety, Adaptability, Availability, User training, Labelling, Operating cost, Disposable, Design Input, ISO 13485.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 3

Design Engineering: Clinical Workflow, Design for Manufacturing, Design for Serviceability, FMEA,

Economy of Scale, Standards in Medtech, Safety and Risk Management, Case studies.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 4

Human Factor Engineering: HE75, Common UI and UA issues, Economy of Scale, Product Requirements, Design engineering, Practical Development process, Importance of verification and review, Iterative development, Design and development plan, Design Output, Design Process, Design Verification, Design Validation, Design Review, Review versus verification versus validation, Design Transfer, Functional Block Diagram, High-Level Design, Signal flow path / Signal Characteristics.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 5

Project Management and sustainability: Activity Planning - Objectives, Defining Activities, Project Plan (Gantt Chart), Network Planning models -Critical path management (CPM), Precedence Network, Nodes, Activity network, Forward Pass, Backward Pass, Float, Critical Path and its importance

Sustainability: Need, external push towards sustainability, hospital role, barriers, making sustainable device, examples.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Identify and analyze unmet clinical need and its requirements to solve the identified need.
2) Search, analyze and document clinical practice, engineering science and relevant literature in order to determine the need for further research and development in a chosen clinical area.
3) develop a sustainable business plan, including market overview, regulation strategies for health & safety of individuals and intellectual property (IP) strategies
4) Understand medical device design engineering and manufacturing process by avoiding common quality pitfalls in turn learning project management (PERT, Critical Path, etc).
5) develop a virtual product of given medical device comprising of requirement analysis, Risk Analysis and management, High level design, usability analysis, verification and validation and present the findings in a team.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered

- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

1. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Biodesign: The Process of Innovating Medical Technologies, by Paul Yock, Stefanos A. Zenios, and Todd J. Brinton, Cambridge University Press, 2nd edition, 2015.
2) Inventing Medical Devices: A Perspective from India, by Jagdish Chaturvedi, Notion Press, 2017.

Reference Books

1) The Medical Device R&D Handbook, by Theodore R. Kucklick, Second Edition, CRC Press, 2012.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of medical device instruments.
- Quizzes,
- Assignments
- Seminars

Wearable Sensors and Medical IoT			Semester	VI
Course and Course Code		**BBM657B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	01		Exam Hours	01
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Understand the basic concepts of Lasers.
- Understand and analyze the classification of Lasers and their energy level diagram.
- Understand and analyze the key elements of Optical Fibre systems.
- Understand the Optical amplifiers and its applications.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only the traditional lecturer method, but a different type of teaching method may be adopted to develop the outcomes.
- Show video/ animation films to explain the functioning of various techniques.
- Encourage group learning in the class.
- Try to arrange some industrial visit to understand various Lasers.
- Give assignments on all topics so that the students will be able to practice any question in the University examination.
- Arrange seminars by the students on certain topics relevant to syllabus.

MODULE – 1

Introduction to Wearable Sensors: Physical and Biophysical parameters measured, Types, Characteristics and Working principles of wearable sensors. Electrochemical and Piezoelectric wearable sensors. Principle, design and development of wearable medical devices: Fingertip Photoplethysmography for Estimation of SpO2, and Heart rate monitoring.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 2

Medical IoT Systems: Introduction, Communication Protocols, System processes, Secure routing: Problems and solutions. The Cloud-side communication – MQTT Protocol. IoT for Wearable devices: Access control and identity management. Challenges, and Approaches to IoT Security.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 3

Wearable Body Sensor Networks (WBSN): Generalized system architecture. System Architecture and Signal Processing Flow. Security requirements in a WBSN, Threats and attacks, Possible solutions for security and privacy in WSBN.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 4

Cyber Security for Wireless Implants: Implantable medical devices (IMDs) – Introduction and Examples, Communication in IMDs. Ethical hacking highlights, IMD security issues, Trade-offs in security designs, Supporting emergency access.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 5

Design of Wireless Health Platforms: System Architecture Requirements for Wireless Health Platforms, System Design. MicroLEAP: A Wireless Health Platform with Integrated Energy Accounting. MicroLEAP Application: SmartCane.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Apply the knowledge of science, engineering and measurement fundamentals to develop wearable sensors.
2) Analyze the trade-offs in security designs and determine accountability, in order to formulate solutions using wearable sensors.
3) Develop solutions for secured communication in medical IoT and Implanted medical devices.
4) Conduct experiments on communication technologies used in medical IoT, both as individuals and in teams, and communicate the results to an engineering community.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Text Books

1) Subhas Chandra Mukhopadhyaay and Tarikul Islam, Wearable Sensors, IOP publishing, 2017
2) Annalisa Bonfiglio, Danilo De Rossi, Editors, Wearable Monitoring systems, Springer, 2011

Reference Books

1) Nilanjan Dey , Amira S. Ashour Simon James Fong, Editors, Wearable and Implantable Medical Devices, Academic press
2) Edward Sazonov, Wearable Sensors: Fundamentals, Implementation and Applications, 2nd edition , Academic Press, 2020

Web links and Video Lectures (e-Resources):

- https://www.udemy.com/course/wearable-technology-a-complete-primer-on-wearables/
- https://www.intechopen.com/books/wearable-technologies/advances-in-wearable-sensing-technologies-and-their-impact-for-personalized-and-preventive-medicine

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Micro Projects
- Quizzes
- Assignments
- Seminars

Optical Instrumentation			Semester	VI
Course and Course Code		**BBM657C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	01		Exam Hours	01
Examination nature (SEE)	Theory			

Course objectives:
After completion of the course, the students will be able to

- Understand the basic concepts of Lasers.
- Understand and analyze the classification of Lasers and their energy level diagram.
- Understand and analyze the key elements of Optical Fibre systems.
- Understand the Optical amplifiers and its applications.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only the traditional lecturer method, but a different type of teaching method may be adopted to develop the outcomes.
- Show video/ animation films to explain the functioning of various techniques.
- Encourage group learning in the class.
- Try to arrange some industrial visit to understand various Lasers.
- Give assignments on all topics so that the students will be able to practice any question in the University examination.
- Arrange seminars by the students on certain topics relevant to syllabus.

MODULE – 1

Introduction to Laser (Lasers -I): Introduction, Emission and absorption of radiation, Einstein relation, population inversion, optical feedback, threshold conditions, Line shape function, population inversion and pumping threshold conditions.
Classes of Laser: Doped insulator Lasers, semiconductor Lasers, Gas Lasers, Liquid dye Lasers.
(Textbook-1)

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 2

Lasers-II: Single mode operation, frequency stabilization, Mode locking and Q-switching.
Applications of Laser: Measurement of distance: Interferometric methods, Beam modulation telemetry; Holography & Holography interferometry.
(Text book-1)

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 3

Optical Fiber Communications: Motivations for light wave communications, optical spectral bands, Network information rates, WDM concepts, Key elements of optical fiber systems, standards for optical

fiber communications, Modeling and simulation tools.

Optical Fibers: Structures, Wave guiding, and Fabrication: The nature of light, basic optical laws and definitions, optical fiber modes and configurations.

(Text book-2)

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 4

Types of Fibers, Material and Fabrication: Single mode fibers, Graded index fiber structure, Fiber materials, Photonic crystal fibers, Fiber fabrication, Fiber optic cables.

Optical Amplifiers: Types of optical amplifiers and its applications, Semiconductor optical amplifiers, Erbium- doped fiber amplifiers, Amplifier noise, Optical SNR, System, Raman amplifiers.

(Textbook-2)

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE – 5

Applications of Lasers in Medicine: Fiberoptic laser systems in cardiovascular disease-Endoscopic laser systems in cardiology, Fiber-optic laser therapy-angioplasty, Endoscopic Nd:YAG Laser therapy in gastroenterology, Laproscopic laser surgery, ophthalmological applications of laser-fiber systems, arthroscopic surgery in orthopaedics, laser lithotripsy. (Textbook-3)

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1) Explain the principle and working of Laser system.
2) Discuss the engineering applications of laser systems.
3) Discuss the fundamentals of optical fiber communications.
4) Evaluate the design of optical fibers.
5) Apply fiber optic laser systems in medical field.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only

one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Text Books

1) Optoelectronics- An Introduction-Wilson & Hawkes, Prentice Hall of India.
2) Optical fiber communications-Geird Keser, McGraw Hill education (India) private limited, Fifth edition.
3) Lasers and Optical Fibers in Medicine - by Abraham Katzir, Academic Press, 1998.

Reference Books

1) LASER Fundamentals- William T. Silfvast, Cambridge University Press.
2) Essentials of Opto Electronics with Applications - A.J. Rogers, CRC press 1997.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/102/108/102108082/
- https://nptel.ac.in/courses/102108082
- https://onlinecourses.nptel.ac.in/noc22_ee67/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of optical sensors and instruments.
- Mini projects using optical sensors and optical instruments.
- Quizzes, Assignments and Seminars

Brain Computer Interface			Semester	VI
Course and Course Code		**BBM657D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0		SEE Marks	50
Total Hours of Pedagogy	40 hours		Total Marks	100
Credits	01		Exam Hours	01
Examination nature (SEE)	Theory			

Course objectives:

After completion of the course, the students will be able to

- Analyze brain signals to reflect activities, controlling behaviour, and information received from other body parts
- Know the EEG classification is an essential component of BCI, allowing communication between the mind and a computer
- Understand feature extraction is an important part of EEG signal classification
- Explain any type of brain signal could be used to control a BCI system, but the most commonly studied signals are electrical signals
- Analyze BCI enables direct communication between the brain and computers to control the external environment
- Acquire the signal acquisition unit is the primary component of a BCI system, sensing and amplifying brain oscillations
- Illustrate BCIs include a sensor to detect and record neural data, and a decoder to process and convert the data into a command signal

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only the traditional lecturer method, but a different type of teaching method may be adopted to develop the outcomes.
- Show video/ animation films to explain the functioning of various techniques.
- Encourage group learning in the class.
- Try to arrange some industrial visit to understand various Lasers.
- Give assignments on all topics so that the students will be able to practice any question in the University examination.
- Arrange seminars by the students on certain topics relevant to syllabus.

MODULE – 1

Basic Neuroscience : Neurons ,Action Potentials or Spikes , Spike Generation ,Adapting the Connections. Brain Organization, Anatomy and Function . Recording and Stimulating the Brain ,Invasive Techniques , Non-invasive Techniques Multielectrode Arrays, Signal Processing ,Spike Sorting.

Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE – 2

Frequency Domain Analysis :Discrete Fourier Transform ,Fast Fourier Transform, Spectral Features , Wavelet Analysis, Time Domain Analysis ,Hjorth Parameters , Fractal Dimension Bayesian Filtering , Kalman Filtering , Particle Filtering ,Spatial Filtering , Bipolar, Laplacian, and Common Average Referencing. Artefact Reduction Techniques : Thresholding ,Band-Stop and Notch Filtering, Linear Modelling Principal Component Analysis ,Independent Component Analysis.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 3	
Machine Learning: Classification Techniques , Binary Classification ,Ensemble Classification Techniques , Multi-Class Classification , Evaluation of Classification Performance ,Regression ,Linear Regression , Neural Networks and Back propagation , Radial Basis Function (RBF) Networks ,Gaussian Processes	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 4	
Building a BCI :Major Types of BCIs ,Brain Responses Useful for Building BCIs ,Imagined Motor and Cognitive Activity, Stimulus-Evoked Activity. Invasive BCIs: Two Major Paradigms in Invasive Brain-Computer Interfacing ,BCIs Based on Operant Conditioning ,BCIs for Prosthetic Arm and Hand Control ,BCIs for Lower-Limb Control ,BCIs for Cursor Control ,Cognitive BCIs ,Cognitive BCIs in Humans , Establishing New Connections between Brain Regions.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE – 5	
Applications and Ethics: Applications of BCIs ,Medical Applications ,Sensory Restoration , Rehabilitation , Restoring Communication with Menus, Lie Detection and Applications in Law ,Monitoring Alertness , Estimating Cognitive Load , Ethics of Brain-Computer Interfacing Medical Health, and Safety Issues : Balancing Risks versus Benefits , Informed Consent BCI Security and Privacy , Legal Issues Moral and Social Justice Issues.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
Course outcomes (Course Skill Set): At the end of the course, the student will be able to: 1) Apply the knowledge of mathematics science and engineering fundamentals to understand the Brain Organization, Anatomy, and Function. 2) Process and analyze the brain signals for artifact reduction. 3) Apply Machine Learning Techniques for the analysis of brain signals 4) Learn the principles of the BCI System, applications and ethics. 5) Apply BCI Techniques using modern tools, present and submit the report.	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/	

course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

1. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1) Brain -Computer Interfacing: An Introduction by Rajesh P. N Rao University of Washington DATE PUBLISHED: September 2013:ISBN:
2) Brain-Computer Interfaces : Foundations and methods Maureen Clerc, Laurent Bougrain, Fabien Lotte

Reference Books

1) Brain-Computer Interfaces 2: Technology and Applications, Volume 2 Maureen Clerc, Laurent Bougrain, Fabien Lotte John Wiley & Sons, 29-Aug-2016 – Computers Schalk, G., & Mellinger, J. (2010).
2) A Practical Guide to Brain–Computer Interfacing with BCI2000: General-Purpose Software for Brain-Computer Interface Research, Data Acquisition, Stimulus Presentation, and Brain Monitoring. Springer Science & Business

Web links and Video Lectures (e-Resources):

- https://sccn.ucsd.edu/wiki/Introduction_To_Modern_Brain- ComputerInterfaceDesign
- https://www.udemy.com/course/brain-computer-interface/

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Quizzes,
- Assignments
- Seminars